REMARKS

Amendment summary

Claims 41 and 42 are newly added. Support for these claims may be found, e.g., on page 28, lines 23-26 of the present specification.

No new matter is added by this Amendment, and Applicants respectfully submit that entry of this Amendment is proper.

Status of the claims

Claims 9-13, 15-20, and 33-34 have been rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as allegedly being obvious over U.S. Patent No. 6,109,506 to Blair et al. ("Blair"). In addition, Claims 9-13 and 15-36 have been rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over U.S. Patent Application Publication No. 2006/0071051 to Shoji et al. ("Shoji").

Response to the rejection of claims 9-13, 15-20, and 33-34 under 35 U.S.C. §§ 102/103 based on Blair

Applicants respectfully submit that the presently claimed invention is not anticipated or rendered obvious by Blair because, as a result of the claimed compositional ranges, the present invention achieves a drastic improvement of tensile strength, breaking elongation, Vickers hardness, and shearing strength in a lead-free solder for soldering electronic components.

Blair does not disclose the above aspects of the presently claimed invention. Instead, Blair discloses a method of enhancing a joint in a metal assembly, where the metal assembly

members may be steel, Zn-coated steel, zinc-alloy coated steel, aluminum, and aluminum alloys. Blair only shows its solder being used for these metal combinations. Further differentiating Blair from the presently claimed invention is that Blair discloses wide temperature ranges for a liquidus temperature (from 190°C to 232°C) and a solidus temperature (from 190°C to 450°C), as shown in Table 1 of Example 1 of Blair. Blair illustrates that the melting point of the solder is about 300°C when, for example, the solder includes 40% zinc with the remainder being tin. For this reason, it would not be possible to use such a solder for soldering electronic components and a circuit substrate. On the other hand, the present application discloses a solder which can be used for soldering electronic components and the circuit substrate.

There is also no indication in Blair that the solder therein could be used for soldering electronic components. Blair discloses a welding method in which high temperatures may be applied to the solder materials (because it is steel, Zn-coated steel, zinc-alloy coated steel, aluminum and aluminum alloys which are being welded). Furthermore, Blair discloses that with respect to flux, arc welding and the like may be used to melt the solder material - even when the solder material and the flux are separately provided. This does not disclose or render obvious the presently claimed invention because it does not take into account properties such as printability and preservation time, which must be considered in order to use a solder for electronic components.

For example, with respect to a cream-type solder, or paste-type solder (where solder particles are incorporated and mixed into the flux), since zinc is easily oxidized, an active ingredient in the flux reacts with the solder particles when the amount of zinc is higher than 10%

as disclosed by Blair, which is also higher than the composition of the present application. Accordingly, the viscosity of the cream-type solder increases such that it is difficult to print in a short amount of time. Likewise, with respect to a resin flux cored solder, or bar solder, when the solder includes an amount of zinc higher than 10% as disclosed by Blair, the flux reacts with zinc oxide. For this reason, it not possible to use such solder for electronic component materials.

Finally, Applicants note that the compositional ranges recited in the present claims take the printability, wettability, and preservation stability properties of the solder into consideration. The presently claimed solder is particularly advantageous because of its strength in soldering for electronic component materials. The solder having the presently recited composition has the same melting point as a conventional Pb-eutectic system with Sn content of 37 wt %. Thus, electronic components can be soldered and packaged using a conventional renew reactor (reflow soldering). The compositional range disclosed by Blair does not anticipate or render obvious the presently claimed invention because is useful only in connecting steel, Zn-coated steel, zinc-alloy coated steel, aluminum, and aluminum alloys.

Applicants therefore submit that the presently claimed invention is not anticipated by or rendered obvious by Blair. Applicants thus respectfully request that the present §§ 102/103 rejection be reconsidered and withdrawn.

Response to rejection of claims 9-13 and 15-36 under 35 U.S.C. § 103(a) based on Shoji

Applicants respectfully submit that claims 9-13 and 15-36 are not rendered obvious by Shoji. In particular, Applicants respectfully submit that Shoji teaches that Ag is present as an

impurity which does not adversely affect the characteristics of the solder metal. Accordingly, there would be no reason to lower the amount of Ag in Shoji to the presently claimed amount of less than 0.1% by weight, and even if Shoji did provide a reason (which it does not), a person having ordinary skill in the art would not expect the unexpectedly superior results of the presently claimed invention (because Shoji discloses that the Ag does not adversely affect the characteristics of the solder metal).

Shoji teaches that Ag is an unavoidable impurity, and also shows that other impurities may include Pb, Sb, Cu, Fe, Al, As, Cd, etc. In addition, Shoji clearly teaches that the amount of each of the unavoidable impurities mingled into the solder metal is 1 mass % or less, and that further intermingling of these elements does not adversely affect the characteristics of the solder metal (see, e.g., Paragraph No. [0034] in Shoji). Shoji does not claim the compositional range of Ag being smaller than 1 mass %. Shoji further fails to disclose or suggest that the presence of less than 1 mass % of Ag would cause an improvement in the characteristics of the solder material, much less that such an improvement would occur in the presence of less than 0.1 wt %, as is presently claimed. The improved tensile strength (see FIG. 8 of the present specification), the superior breaking elongation (see FIG. 9 of the present specification), and the superior Vickers hardness (see FIG. 10 of the present specification) of the present solder are not disclosed or suggested by Shoji.

Applicants note that the Examiner has taken the position that a solder alloy with a lower concentration of impurities will more readily wet the materials to be bonded. However, Applicants respectfully note that lowering the concentration of Bi, for example, actually

degrades the wettability of the solder material. Therefore, lowering the impurity concentration is not always sufficient to enhance the wettability of the solder material.

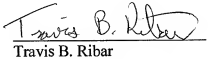
Applicants therefore submit that the presently claimed invention is not rendered obvious by Shoji. Applicants thus respectfully request the reconsideration and withdrawal of the present §103 rejection.

Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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